REMARKS

The Office Action dated December 17, 2002 has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Applicants have amended Figures 1-5 and submitted replacement sheets, as suggested by the Office Action. Applicants have submitted a Substitute Specification in order to respond to the Office Action's request to add reference numerals to the drawings. Accordingly, Applicants have amended the specification to be consistent with the revisions to Figures 1-5. Therefore, Applicants, therefore, respectfully submit a Substitute Specification. A marked-up version, showing all the changes to the substitute specification, is also submitted.

Claims 1-14 are pending in the application. By this amendment, Applicants have amended claims 1, 2, 4, 6, and 10 to more particularly point out and distinctly claim the present invention. Applicants have added claim 14. In view of the following remarks, reconsideration and allowance of these claims is respectfully requested.

I. FORMALITY OBJECTIONS

The Office Action indicated that all the references except for the International Search Report for PCT/F199/01070 and the GSM reference (Mouly and Pautet) were

considered by the Examiner. The Office Action further requested that Applicants identify what pages of the GSM reference are relevant to the present applicant.

Applicants submit that the GSM reference is specifically mentioned in the discussion on page 5, lines 32-33 of the specification. This discussion informs any interested reader that the GSM reference can be used as "background information" to assist in understanding the GSM system in general. Applicants further submit that, due to the general nature and comprehensiveness of the GSM references, it would not be feasible to identify all the relevant sections from such a document. Applicants, therefore, submit that they do not wish to have this reference considered by the PTO.

II. DRAWINGS

The Office Action objected to Figures 1-5 because the Office Action suggested that these figures should include reference numerals on all boxes. As suggested by the Office Action, Applicants have amended Figures 1-5 to include such reference numerals. Thus, Applicants respectfully request the withdrawal of these objections.

III. CLAIM REJECTIONS UNDER 35 U.S.C. §102

Claims 1-13 were rejected under 35 U.S.C. §102(b) as being anticipated by Kapadia (U.S. Patent No. 5,768,314). The Office Action alleges that Kapadia teaches all of the limitations of the claimed invention. Applicant respectfully submits that the prior art cited in the Office Action fails to teach, suggest or disclose the features of the claimed invention.

Claim 1, upon which claims 2-3 are dependent, recites a method for boosting data transmission in a telecommunications system comprises a fixed station, a terminal equipment, and a transcoder unit. A first transmission path connects the terminal equipment with the fixed station and a second transmission path connects the fixed station and the transcoder unit. The first transmission path uses a first speech coding method. A second speech coding method is used on at least on a part of the second transmission path a second speech coding method is used. The second speech coding method is speech coding at a lower transmission rate than the first speech coding method. The speech parameters received from the terminal equipment for transmission onto the second transmission path are converted into speech parameters of the second speech coding method, and speech parameters to be transmitted to the terminal equipment on the first transmission path are converted into speech parameters of the first speech coding method.

Claim 4, upon which claim 5 is dependent, recites a method for boosting data transmission in a mobile communications system comprises a base transceiver station and a transcoder unit. A transmission path connects the mobile stations over a radio path with the base transceiver station. The mobile communications system on the radio path uses a first speech coding method. A second speech coding method is used on at least on a part of the transmission path. The second speech is speech coding at a lower transmission rate than the first speech coding method. Speech parameters received from the mobile station for transmission onto the transmission path are converted into speech parameters of the

second speech coding method, and speech parameters to be transmitted to the mobile station on the radio path are converted into speech parameters of the first speech coding method.

Claim 6, upon which claims 7-9 are dependent, recites an arrangement for boosting data transmission in a telecommunications system comprises a fixed station, a terminal equipment, and a transcoder unit. A first transmission path connects the terminal equipment with the fixed station, and a second transmission path connects the fixed station and the transcoder unit. The first transmission path uses a first speech coding method. At least one first speech coder converts speech parameters to be transmitted between the first and the second speech coding method. The second speech coding method is used on the transmission path on the transmission connection between the speech coder and the transcoder unit. The second speech coding method is speech coding at a lower transmission rate than the first speech coding method.

Claim 10, upon which claims 11-13 are dependent, recites a mobile communications system comprises base transceiver station and a transcoder unit. A transmission path connects the mobile stations over a radio path with the base transceiver station. The mobile communications system on the radio path uses a first speech coding method. At least one first speech coder converts speech parameters to be transmitted between a first and a second speech coding method. The second speech coding method is used on the transmission path on the transmission connection between the speech coder

and the transcoder unit, and the second speech coding method is speech coding of a lower transmission rate than the first speech coding method.

As a result of the claimed invention, a system and method for boosting of data transmission is provided. One advantage of the present invention is that less transmission capacity is needed per speech connection, at least, in a part of a transmission connection between a base transceiver station and a transcoder unit of the network. Another advantage of the data communications system according to the invention is that the system allows the transmission of data between terminal equipment using different speech coding methods. These advantages are not all inclusive but merely exemplars of some of the benefits of the invention.

Kapadia discloses an apparatus and method for providing a combination full/half rate service type comprising a half rate speech code and a full rate channel codec having a front end arranged for communication with the half rate speech codec wherein the front end includes a bit mapping re-ordering module. Speech is delivered to an input 10 of an audio interface 12 of a mobile station 11. The audio interface transmits the speech to a first half speech codec for providing coded signals. The coded signals are delivered to a parameter sensitivity bit re-ordering module 33 of the coded signals. The re-ordered bits are delivered to a full rate channel codec 20 for further processing. The output of the full rate channel codec is transmitted over the air via RF interfaces 22 to a second hybrid channel processor 31 located at a base transceiver station 13.

Applicant submits that Kapadia fails to disclose or suggest the elements of the invention as set forth in the claimed invention, and thereby fails to provide the critical and nonobvious advantages that are provided by the invention. In order to anticipate a claim, it is well established that a reference must disclose every element of the claim. *Verdegaal Bros. V. Union Oil Co.,* 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.,* 9 USPQ2d (Fed. Cir. 1989)

Applicants respectfully submit that Kapadia does not anticipate the claimed invention because Kapadia fails to disclose or suggest several limitations of the claimed invention. Broadly speaking, the present invention is concerned with defining first and second transmission paths wherein speech coding is performed to convert the transmission rate on the second transmission path to a rate lower than on the first path. Kapadia fails to disclose or suggest several features of the claimed invention. For instance, Kapadia does not disclose that the second speech coding is "*speech coding (on the second transmission path) at a lower transmission rate than the first speech coding (on the first transmission path)*". Instead, Figure 3 of Kapadia shows a half-rate speech codec 30 existing on the path between the mobile station 11 and the fixed terminals 13, as well as a half-rate speech codec 37 in the path between the BS 11 and network. Thus, in Kapadia, the path from the BS to the network does not have a speech coding transmission rate lower than the speech coding rate on the path between the MS and the BS.

Another distinction is that Figure 3 of Kapadia shows that half-rate speech codec 37 is responsible for converting into the 64kbit/s speech (see column 3 lines 52-55 of Kapadia) and therefore this is analogous to the transcoding unit (TRAU) of the present application (see Figure 1 of the present application). Therefore, if anything, the transmission rate on the second transmission path (i.e. between base station 13 and the half-rate codec 37) is the full rate channel codec 21, which is not lower than the rate used on the first channel.

Claim 1 recites that "*the first transmission path uses a first transmission method*" and on "*the second transmission path a second speech coding method is used.*" The speech coder (45, 55) of the present invention is used to decode and recode so that speech parameters are converted between a first and a second speech coding <u>method</u> (see page 6 lines 33 to page 7 line 1, inter alia). Claim 1 reinforces this idea in reciting that "*speech parameters received from the terminal equipment are converted into speech parameters of the second speech coding*". Thus apart from the transmission speeds of the respective transmission paths differing, the coding methods used on the respective paths of the present application can also differ, for example, the EHR (enhanced half-rate) and EFR (Enhanced full-rate) speech coding methods described. Kapadia does not disclose respective methods of speech coding.

The described embodiments of the present application exemplify further distinctions between the claimed invention and Kapadia. For instance, the embodiments show that speech coding is performed on the network-side of the communication system,

i.e. either at the transcoding units (TRAU) 55 or at the base stations (BTS) 45. Therefore, because speech coding is done on the network-side (i.e. the BTS), the present application is not dependent on the transmission rate used by the mobile station and so both half-rate and full-rate speech coding can be used equally well. In contrast, Figure 3 of Kapadia plainly shows that the speech and channel coding is performed within the mobile station 11 itself. Therefore, claim 1 of the present application is further distinguished in reciting "*speech parameters received* <u>*from the terminal equipment*</u> *...are converted into speech parameters of the second speech coding method.*" That is, the conversion is not performed in the mobile station per se.

Another reason that Kapadia does not anticipate the claimed invention is that the transmission rate, which is to be used on the transmission path between a base transceiver station and the transcoder unit, is determined, as discussed on page 9, lines 17-35. The transmission rate of speech parameters received from a mobile station at the base transceiver station is determined—that is, the transmission rate used on the radio path. The transmission rates determined above are compared with one another. If the radio path transmission rate is <u>higher than</u> the transmission rate of the transmission path between the base transceiver station and the transcoder unit, the speech parameters are decoded and they are recorded by the second speech coding, which is used on the transmission path between the base transceiver station and the transcoder unit. The speech parameters thus processed are transmitted from the base transceiver station to the transcoder unit over the transmission path.

Kapadia, however, does not compare two different signals and based upon that comparison determine the transmission rate. Instead, in Kapadia, a hybrid channel processor or codec merely determines what mode of operation or channel service type is desired. If it is full rate, then the normal full rate speech coding or decoding is implemented. If either half rate or full/half is desired the normal half speech coding or decoding is implemented.

Thus, Kapadia does not anticipate the claims 1, 4, 6 and 10.

In addition, claims 2-3 depend from claim 1, claims 5 depends from claim 4, claims 7-9 depend from claim 6, and claims 11-13 depend from claim 10 and are therefore allowable at least for the reasons claims 1, 4, 6 and 10 are allowable, respectively, and for the specific limitations recited therein.

CONCLUSION

As discussed above, claims 1-14 are pending in the application. Claims 10-12 have been objected to. By this Amendment, Applicant has amended claims 1, 2, 4, 6, and 10 to more particularly point out and distinctly claim the present invention. New claim 14 has been added. No new matter has been added and no further search is required. Applicant submits that Kapadia fails to disclose or suggest several limitations of the claimed invention as discussed above. Thus, Applicants submit that certain clear and important distinctions exist between the cited prior art and the claimed invention.

Applicant submits that these distinctions are more than sufficient to render the claims of the invention unanticipated by and unobvious in view of the prior art.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

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Enclosures: Replacement Sheets for Figures 1-5
Revocation and New Power of Attorney
Substitute Specification
Marked-up Substitute Specification

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MARKED-UP
SUBSTITUTE SPECIFICATION

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Boosting of data transmission

Field of the invention

This invention concerns a method of boosting data transmission in a telecommunications network.

Background of the invention

In Figure 1 of the appended drawing a simplified Global System for Mobile communications, a GSM system for short, is shown as a block diagram. The Network Subsystem, NSS, includes a mobile services switching centre MSC <u>2</u> which is connected to other mobile services switching centres, and directly or through a Gateway Mobile Services Switching Centre, a GMSC system interface the mobile network is connected to other networks, such as a Public Switched Telephone Network, PSTN <u>4</u>, an Integrated Services Digital Network, ISDN <u>6</u>, other Public Land Mobile Networks, PLMN <u>10</u>, and packet switched public data networks, PSPDN <u>12</u>, and circuit switched public data networks, CSPDN <u>14</u>. In the mobile services switching centre MSC <u>2</u> there are Network Interworking Functions, IWF <u>16</u>, for matching the GSM network with the other networks. Through an A-interface the NSS network subsystem is connected to a Base Station Subsystem, BSS, which includes base station controllers BSC <u>20</u>, each one of which controls the base transceiver stations BTS <u>22</u> connected to them. The interface between the base station controller BSC and the base transceiver stations BTS connected to it is an A bis interface. The base transceiver stations BTS <u>22</u> for their part are connected over a radio path with mobile stations MS <u>24</u> across the radio interface. The operation of the whole system is monitored by an Operation and Maintenance Centre, OMC.

The mobile station MS <u>24</u> sends speech or user data across the radio interface on a radio channel at standard rates of e.g. 13 kbit/s or 5.6 kbit/s. Speech coding is used in the speech transmission to achieve a lower transmission rate than typically in telephone networks, whereby the band width needed by the radio link on the radio path is reduced. The base transceiver station BTS <u>22</u> receives the data of the traffic channel and transmits it into the 64 kbit/s time slot of the PCM line. Into the same time slot, that is, channel, are also placed three other full-rate traffic channels of the same carrier wave, so the transmission rate per connection will be 16

kbit/s. For half-rate traffic channels the transmission rate is 8 kbit/s per connection. A transcoder/rate adapting unit TRAU 26 converts the coded 16 kbit/s or 8 kbit/s digital information to the 64 kbit/s channel, and on this channel the data is transmitted to an IWF 16 unit which is located in the mobile services switching centre MSC 2 and which performs the required modulation and rate conversion, whereupon the data is transmitted to some other network. Thus, the user data is transmitted over fixed connections in the uplink direction from base transceiver station BTS 22 to base station controller BSC 20 and to mobile services switching centre MSC 2 and, correspondingly, the data to be relayed to mobile station MS 24 is transmitted in the downlink direction from mobile services switching centre MSC 2 through base station controller BSC 20 to base transceiver station BTS 22 and from there further over the radio path to mobile station MS 24.

In the GSM system, a Channel Codec Unit, CCU, of the base transceiver station performs a conversion of the signal received on the radio channel to the PCM time slot channel of the trunk line running over the A bis interface and a conversion of the frame structure of the signal received over the A bis interface into a form which can be transmitted on the radio channel. The transcoder unit TRAU 26 performs the conversion operations on the signals to be transmitted across the A-interface. The transcoder/rate adapting unit TRAU 26 is often located far from the base transceiver station 22, e.g. in connection with the base station controller BSC 20.

In a digital mobile system, speech is generally coded into a digital form by using low rate speech coding. Nowadays the SM system uses Full Rate FR 30 coding at a transmission rate of 13 kbit/s, Half Rate HR 32 coding at a transmission rate of 5.6 kbit/s, Enhanced Full Rate EFR 30' coding at a transmission rate of 12.2 kbit/s and Enhanced Half Rate EHR 32' coding. The enhanced speech codings 30', 32' are so advanced that the quality of speech is not significantly reduced in them.

Thus, speech coding is performed in the mobile station and on the mobile network side in the transcoder unit TRAU 26. The speech information to be transmitted is one of the parameters of the speech coding method. In modern GSM systems the TRAU 26 transcoders are of several different types of coding, e.g. full rate, half rate or double acting, which is able to change from one rate to another. The transcoders convert the speech from a digital format into another, e.g. they convert 64 kbit/s A-law PCM arriving

from the exchange over the A interface into 13 kbit/s full rate FR 30 coded speech for transmission to the base transceiver station line, and vice versa. In a call between two mobile stations PCM speech samples are transmitted from one transcoder to another, which codes them by a speech coding method which is used on the radio path. Repeated coding and decoding of the speech signal during the transmission will distort the speech signal, for which reason this coding-decoding chain, which is called tandem coding, is usually avoided.

The Finnish Patent Application FI-951807 presents transmission of speech frames, which have not been decoded, between transcoders and thus barring of tandem coding in the transcoder, when the call is one between two mobile stations, that is, a Mobile to Mobile Call, MMC. In the solution according to the application, the coded speech parameters are sent on the PCM time slot sub-channel without any decoding and coding in the TRAU transcoders of the mobile station network. Tandem coding is avoided by relaying with minor changes the frames coming from one base transceiver station BTS 22 through these tandem connected TRAU 26 transcoders to another base transceiver station BTS 22'. The receiving transcoder will perceive from these minor changes in the frame that coding need not be done, and it will relay further the received speech parameters of the frame as such.

The Finnish Patent Application FI-960590 presents a transmission adaptation for a connection between exchanges. In the solution according to the application, a speech signal is transmitted coded by a speech coding method on a sub-channel of a PCM channel. The speech coding for the connection between exchanges is chosen according to the speech coding of the TRAU frames of the A-interface, except if the speech coding of the TRAU frames received from the A-interface is different from the speech coding of TRAU frames received from other transmission equipment, that is, if the parties to the call are using different speech codings. Figures 2a - 2c illustrate this adaptation of the transmission for a connection between exchanges in a few cases shown as examples. The speech coding used in each part of the transmission path is marked in the figures, in this example they are full rate FR 30 and half rate HR 32 speech coding. In Figure 2a both mobile stations MS1 24 and MS2 24' use the full rate FR 30 speech coding method. Hereby the speech parameters are transmitted through the mobile

station network as unchanged full rate speech parameters. In Figure 2b both mobile stations MS1 and MS2 use a half rate HR 32 speech coding method. Hereby the speech parameters are transmitted through the mobile station network as half rate speech parameters. In the case shown in Figure 2c, mobile station MS1 uses half rate HR speech coding while mobile station MS2 uses full rate FR 30 speech coding. In this situation, a change is made at the mobile services switching centre MSC1 end to full rate speech coding and the necessary decoding and speech coding are performed.

A problem with the presented transmission situations is the need of transmission capacity, especially on the transmission connection between the base transceiver station and the network transcoder. The transmission in the mobile station network of speech parameters of the mobile station using full rate speech codec requires a full rate channel, which cannot be transmitted, if on the transmission connection e.g. only a half of that transmission capacity is available, which is required by a full rate signal.

Brief summary of the invention

The purpose of this invention is to boost data transmission especially in transmission connections on the network side of a mobile communications system.

This objective is achieved with the method and arrangement according to the invention, which are characterised by the features stated in the independent claims. Advantageous embodiments of the invention are presented in the dependent claims.

The invention is based on the idea that the data communications network uses at least in a part of the transmission path between a fixed station, e.g. a base transceiver station, and a transcoder unit a lower transmission rate speech coding than the transmission rate of the speech coding used on the transmission path between the fixed station and the terminal equipment. The speech parameters received from the terminal equipment are converted to the speech coding method used in the transmission connection between the fixed station and the transcoder unit, and vice versa. In the transcoder unit of the network it is possible to convert speech parameters received from the terminal equipment back to e.g. the speech parameters of the speech coding used on the transmission path between the terminal equipment and the fixed station.

It is an advantage of such boosting of data transmission that less transmission capacity is needed per speech connection at least in a part of the transmission connection between the base transceiver station and the transcoder unit of the network.

It is another advantage of the data communications system according to the invention that it allows trafficking between terminal equipment using different speech coding methods, at best with only one speech coding during the transmission.

List of figures

The invention will now be described in greater detail in connection with advantageous embodiments and referring to the examples in accordance with Figures 3 - 6b in the appended drawings, wherein:

Figure 1 shows such parts of a mobile communications network which are essential to the invention;

Figures 2a-2c show examples of state-of-the-art speech transmission situations;

Figure 3 is a speech transmission diagram of data transmission boosting according to the invention;

Figures 4a and 4b show speech transmission situations according to a first embodiment of the invention as examples;

Figures 5a and 5b show speech transmission situations according to another embodiment of the invention as examples; and

Figures 6a and 6b show flow charts of data transmission boosting according to the invention.

Detailed description of the invention

The present invention may be applied in connection with any telecommunications system. The invention will be described hereinafter by way of example and mainly in connection with a digital GSM mobile communications system. Figure 1 shows the simplified structure of the GSM network described above. The interested reader will find background information as regards a more detailed description of the GSM system from GSM recommendations and from the book "The GSM System for mobile Communications", M. Mouly & M. Pautet, Palaiseau, France, 1992, ISBN:2-

9507190-0-7.

Figure 3 shows boosting of data transmission in a mobile communications system in accordance with the invention. In the case shown as an example in Figure 3, the mobile station MS 24 uses full rate speech coding 30. Hereby speech parameters of full rate FR 30 speech coding are transmitted between base transceiver station BTS 22 and mobile station MS 24. According to the invention, the speech parameters are converted for a transmission connection between base transceiver station BTS 22 and the network transcoder unit TRAU 26 into speech parameters of speech coding of a lower transmission rate, in the case shown in Figure 3 into speech parameters of half rate speech coding 32. Thus, the speech parameters received from the mobile station are decoded at the end of base transceiver station BTS 22 and a new speech coding is carried out by a speech coding method of a lower transmission rate, in the case shown in Figure 3 by half rate speech coding 32. The new speech parameters thus obtained are transmitted over the transmission connection to the transcoder unit TRAU 26. Correspondingly, the speech parameters received from transcoder unit TRAU 26 are decoded at the end of base transceiver station BTS 22 and a new speech coding is performed by a speech coding method available on the radio path, in the case shown in Figure 3 by full rate speech coding 30. The resulting speech parameters are transmitted to mobile station MS 24 over the radio path. When required, a corresponding conversion of the speech parameters is performed at the end of transcoder unit TRAU 26 to transmit speech elsewhere in the network and from elsewhere in the network to the base transceiver station connection. From transcoder unit TRAU 26 the speech is transmitted elsewhere in the network in some state-of-the-art manner. Instead of the speech codings 30, 32 shown in Figure 3 other speech codings may also be used, however, so that the speech coding in use in the connection between the base transceiver station 22 and the transcoder unit 26 is a speech coding of a lower transmission rate than the speech coding used on the radio path.

In the following the invention will be described in greater detail in the light of a first embodiment of the invention and referring to Figures 4a and 4b. In the first embodiment of the invention, a speech coder 45 according to the invention is located when required in connection with base transceiver station BTS 22 to decode and recode the call to be relayed so

that the speech parameters to be transmitted are converted between a first and a second speech coding method. Figure 4a shows a call transmission connection between two mobile stations MS1 24 and MS2 24' as an example. Mobile station MS1 24 uses enhanced full rate speech coding EFR 30' and mobile station MS2 uses enhanced half rate speech coding EHR 32'. Base transceiver station BTS1 receives the EFR 30' speech parameters from mobile station MS1 24. The speech coder according to the invention decodes them and recodes by enhanced half rate speech coding HER 32'. These EHR 32' speech parameters are transmitted through base station controller BSC1 20 to transcoder unit TRAU1 26 and from there further by using state-of-the-art barring of tandem coding as EHR 32' speech parameters by way of exchanges MSC1 2 and MSC2 2' to transcoder unit TRAU2 26', which transmits the EHR 32' speech parameters further through base station controller BSC2 20' to base transceiver station BTS2 22'. At the end of base transceiver station BTS2 22' the EHR 32' speech parameters are transmitted over the radio path to mobile station MS2 24', where enhanced half rate speech coding EHR 32' is used. Thus, in the speech transmission described above, only one decoding and recoding of speech coding is performed on the mobile station network side. Correspondingly, the EHR 32' speech parameters received from mobile station MS2 24' are transmitted unchanged over the transmission network to the end of base transceiver station BTS1 22, where a speech coder according to the invention decodes them and carries out recoding by enhanced full rate speech coding 30'. These EFR 30' speech parameters are transmitted from base transceiver station BTS1 22 over the radio path to mobile station MS1 24.

Figure 4b is an example of another situation showing a call transmission connection between two mobile stations MS1 24 and MS2 24' where both mobile stations MS1 24 and MS2 24' use enhanced full rate speech coding EFR 30'. Base transceiver station BTS1 22 receives the EFR 30' speech parameters sent by mobile station MS1 24. In order to boost the data transmission on the connection between the base transceiver station and the network transcoder unit, the speech coder according to the invention decodes the speech parameters received at base transceiver station BTS1 22 and recodes the speech by enhanced half rate speech coding 32'. The resulting EHR 32' speech parameters are transmitted to transcoder unit

TRAU1 26, which again transmits the EHR 32' speech parameters unchanged through exchanges MSC1 2 and MSC2 2' to transcoder unit TRAU2 26'. TRAU2 26' sends the EHR 32' speech parameters to base transceiver station BTS2 22'. Before being transmitted onto the radio path, the received EHR 32' speech parameters are decoded in a speech coder according to the invention and they are recoded by the enhanced full rate speech coding available on the radio path. The EFR 30' parameters are transmitted to mobile station MS2 24'. Correspondingly, the same procedure is used for the EFR 30' speech parameters of mobile station MS2 24' which are received at base transceiver station BTS2 22'.

Figures 5a and 5b show examples of situations in accordance with another embodiment of the invention. In this second embodiment of the invention a first speech coder 45 is located in connection with the base transceiver station, besides which another speech coder 55 is located in connection with transcoder TRAU 26 also to decode and recode the speech to be relayed so that the speech parameters are converted between a first and a second speech coding method. Figure 5a shows a speech transmission connection between two mobile stations MS1 24 and MS2 24', when both mobile stations use enhanced full rate speech coding 30'. The EFR 30' speech parameters received by base transceiver station BTS1 22 from mobile station MS1 24 are converted in accordance with the invention into EHR 32' parameters and they are transmitted to transcoder unit TRAU1 26 in the same manner as was described above in connection with the first embodiment of the invention. The EHR 32' speech parameters received in transcoder unit TRAU1 26 are converted in a speech coder in accordance with the invention for a transmission rate of enhanced full rate speech coding. When required, the speech parameters may also be converted into PCM samples. At the transmission rate of enhanced full rate speech coding the speech is transmitted from transcoder unit TRAU1 26 through exchanges MSC1 2 and MSC2 2' to transcoder unit TRAU2 26'. The speech received in transcoder unit TRAU2 26' is converted in a speech coder 55' according to the invention back to EHR 32' speech parameters, which are transmitted to base transceiver station BTS2 22'. Before being transmitted onto the radio path, the EHR 32' speech parameters are converted in accordance with the invention into EFR 30' speech parameters, as was described above in connection with a first embodiment of the invention.

Figure 5b shows an example of another situation where mobile station MS1 24 uses enhanced full rate speech coding EFR 30' and mobile station MS2 24' uses enhanced half rate speech coding EHR 32'. The EFR 30' speech parameters received at base transceiver station BTS1 22 are converted in accordance with the invention into EHR 32' speech parameters and they are transmitted to transcoder unit TRAU1 26 in the same manner as was presented above in connection with the description of Figure 4a. The EHR 32' speech parameters received in transcoder unit TRAU1 26 are converted in a speech coder 55 according to the invention into a transmission rate of enhanced full rate speech coding 30'. When required, the speech parameters may also be converted into PCM samples. At the transmission rate of enhanced full rate speech coding 30' the speech is transmitted from transcoder unit TRAU1 26 through exchanges MSC1 2 and MSC2 2' to transcoder unit TRAU2 26'. The speech received in transcoder unit TRAU2 26' is again converted in a speech coder according to the invention into EHR 32' speech parameters, which are transmitted to base transceiver station BTS2 22' and from there further over the radio path to mobile station MS2 24'. The EHR 32' speech parameters received from mobile station MS2 24' are converted correspondingly in a reversed order when transmitting the speech in the network from base transceiver station BTS2 22' to base transceiver station BTS1 22.

Figure 6a shows boosting of data transmission in accordance with the invention in a mobile communications system in the uplink direction. At point 602 the transmission rate is determined which is to be used on the transmission path between the base transceiver station and the transcoder unit, and at point 604 the transmission rate of speech parameters received from mobile station MS at the base transceiver station is determined, that is, the transmission rate used on the radio path. At point 606 the transmission rates determined above are compared with one another. If the radio path transmission rate is higher than the transmission rate of the transmission path between the base transceiver station and the transcoder unit, the speech parameters are decoded (point 608) and they are recoded by the second speech coding, which is used on the transmission path between the base transceiver station and the transcoder unit (point 610). The speech parameters thus processed are transmitted from the base transceiver station to the transcoder unit over the transmission path (point 612). If in the check

at point 606 the radio path transmission rate is not higher than the transmission rate of the transmission path, then the speech parameters are processed in a state-of-the-art manner and they are transmitted further in the network.

Figure 6b shows boosting of data transmission in accordance with the invention in a mobile communications system in the downlink direction. At point 622 the transmission rate used on the radio path is determined, while at point 624 the transmission rate of speech parameters received from the transcoder unit at the base transceiver station are determined. At point 626 a comparison is made between the transmission rates determined above. If the transmission rate used on the transmission path between the base transceiver station and the transcoder unit is lower than the transmission rate of the radio path, then the received speech parameters are decoded (point 628) and they are recoded by a first speech coding, which is used on the radio path (point 630). The reprocessed speech parameters are transmitted from the base transceiver station to the mobile station over the radio path (point 632). If it is found in the check at point 626 that the transmission rate of the transmission path is not lower than the transmission rate of the radio path, then the speech parameters are transmitted to the mobile station in a state-of-the-art manner.

The speech coder in accordance with the invention supports two or more speech coding methods, which are used in a telecommunications system, preferably in a mobile communications system. The speech coder according to the invention may also be used in other situations than those shown in the preceding examples to implement the functionality according to the invention.

In mobile station MS speech coding and decoding are performed in a state-of-the-art manner, which is why it is not described in greater detail in this connection.

The drawings and the related explanation are intended only to illustrate the inventive idea. As regards its details the boosting of data transmission in accordance with the invention may vary within the scope of the claims. Even though the invention was described above mainly in connection with a mobile communications system, the boosting of data transmission may be used also for a telecommunications system of some other kind, when the telecommunications system uses a low transmission

rate speech coding on the transmission path between the fixed station and the terminal equipment. Thus, in the present application a base transceiver station means any such unit in a telecommunications network which is in connection with pieces of terminal equipment, whereas a mobile station means both mobile and fixed pieces of terminal equipment which are in connection with a telecommunications network. The functionality according to the invention may be implemented in the network for all connections or for some connections only.